

Missouri Department of Natural Resources

Total Maximum Daily Load Information Sheet

Mississippi River

Waterbody Segment at a Glance:

County: Jefferson
Nearby Cities: Herculaneum
Length of impairment: 5 miles
Pollutant: Lead and Zinc in Stream
Sediments
Source: Herculaneum Smelter

Added to the 2002 303(d) list

TMDL Priority Ranking: High



State map showing location of Herculaneum Smelter

Description of the Problem

Beneficial uses of Mississippi River

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life
- Protection of Human Health associated with Fish Consumption
- Irrigation
- Boating and Canoeing
- Drinking Water Supply
- Industrial

Use that is impaired

- Protection of Human Health associated with Fish Consumption

Standards that apply

- Missouri Water Quality Standards (WQS) do not contain numeric criteria for metals in sediment. The high levels of lead and zinc represent a violation of the general criteria found in the WQS 10 CSR 20-7.031(3)(D) where it states:
 - Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life.Also in WQS 10 CSR 20-7.031(4)(B)1 it reads:
 - Concentrations of [contaminants] in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.

Background information and Water Quality Data

Wet weather runoff from the Herculaneum smelter area flows directly into Joachim Creek. Attempts to analyze sediment from Joachim Creek have failed due to a lack of fine sediments in the river downstream of the smelter. However, these metals have been detected in the Mississippi River below the confluence with Joachim Creek. Levels of lead and zinc reported in some Mississippi sediments (see Table 1 below) are well in excess of values commonly reported as toxic to aquatic life. Zinc is an essential nutrient to aquatic and terrestrial organisms, but in excess quantities both lead and zinc can be highly toxic to aquatic life.

Table 1. Metals in Mississippi River sediments, 1995 (mg/kg, dry weight) Note: Milligrams per kilogram (mg/kg) is the same as parts per million.				
Site #	1	2	3	4
Arsenic	4.9	15	5.2	4.3
Cadmium	0.7	33	32	<0.2
Chromium	20	25	25	27
Copper	18	1,060	1,030	13
Mercury	0.04	0.03	0.06	0.04
Lead	37	7,720	7,590	23
Nickel	22	98	92	13
Zinc	101	29,400	28,800	84

Source: U.S. Fish & Wildlife Service

Lead and zinc in sediments may be absorbed by fish and other aquatic life and incorporated into their bodies. Consumption of fish containing sufficient quantities of lead may cause human health problems. In humans, lead primarily affects the nervous system, blood cells, and processes for the metabolism of Vitamin D and calcium. Lead can affect the developing fetus during pregnancy and may cause lower IQ scores in children. Lead poisoning may also result in poor attention spans, hearing, speech and language problems, reading disabilities, reduced motor skills and poor hand-eye coordination. Evidence suggests that lead toxicity may occur at levels as low as 10 micrograms per deciliter (µg/dL) of blood.

Levels of lead in fish are shown in Tables 2-4. Very high levels of lead are shown in samples collected by the U.S. Fish and Wildlife Service in 1993 and probably reflect an effort to sample fish in backwater areas where sediment contamination was greatest. Fish tissue sampling by U.S. Environmental Protection Agency and Missouri Department of Natural Resources (the department) and by the Missouri Department of Conservation (MDC) data shows much lower levels of lead. Sampling by these agencies is primarily done to characterize fish tissue quality in larger areas of the river and was not focused on backwater areas in the immediate vicinity of the Herculaneum Smelter.

Table 2. Mean Levels of Lead [Mg/Kg] in Whole Fish Collected in the Mississippi R. near the Herculaneum Smelter by the U.S. Fish and Wildlife Service, 1993.		
Species	1 Mile Upstream of Joachim Cr.	1 Mile Downstream of Joachim Cr.
Carp	0.069 (2)*	4.383 (2)
Channel Catfish	0.174 (2)	1.220 (2)
Carpsucker	0.272 (2)	2.167 (2)

Table 3. Mean Levels of Lead [Mg/Kg] in Whole Fish Collected in the Mississippi R. near the Herculaneum Smelter by Mo.DNR/USEPA 1984-2002		
Species	Near Kimmswick, Mo. (upstream)	Near Festus, Mo. (downstream)
Carp	<.170 (4)	<.170 (2)
Buffalo	.000 (1)	
White Bass	<.170 (1)	<.170 (1)

Table 4. Mean Levels of Lead [Mg/Kg] in Fish Fillets Collected in the Mississippi R. near the Herculaneum Smelter by the Mo. Dept. of Conservation, 1989-2001		
Species	Near Kimmswick, Mo. (upstream)	Near Festus, Mo. (downstream)
Sturgeon		.028 (2)
Carp	.055 (12)	.018 (6)
Catfish	.057 (5)	.023 (3)
Buffalo		.030 (1)
Bass	.009 (4)	

*Note- the numbers in parentheses are the number of fish tissue samples used to calculate the mean

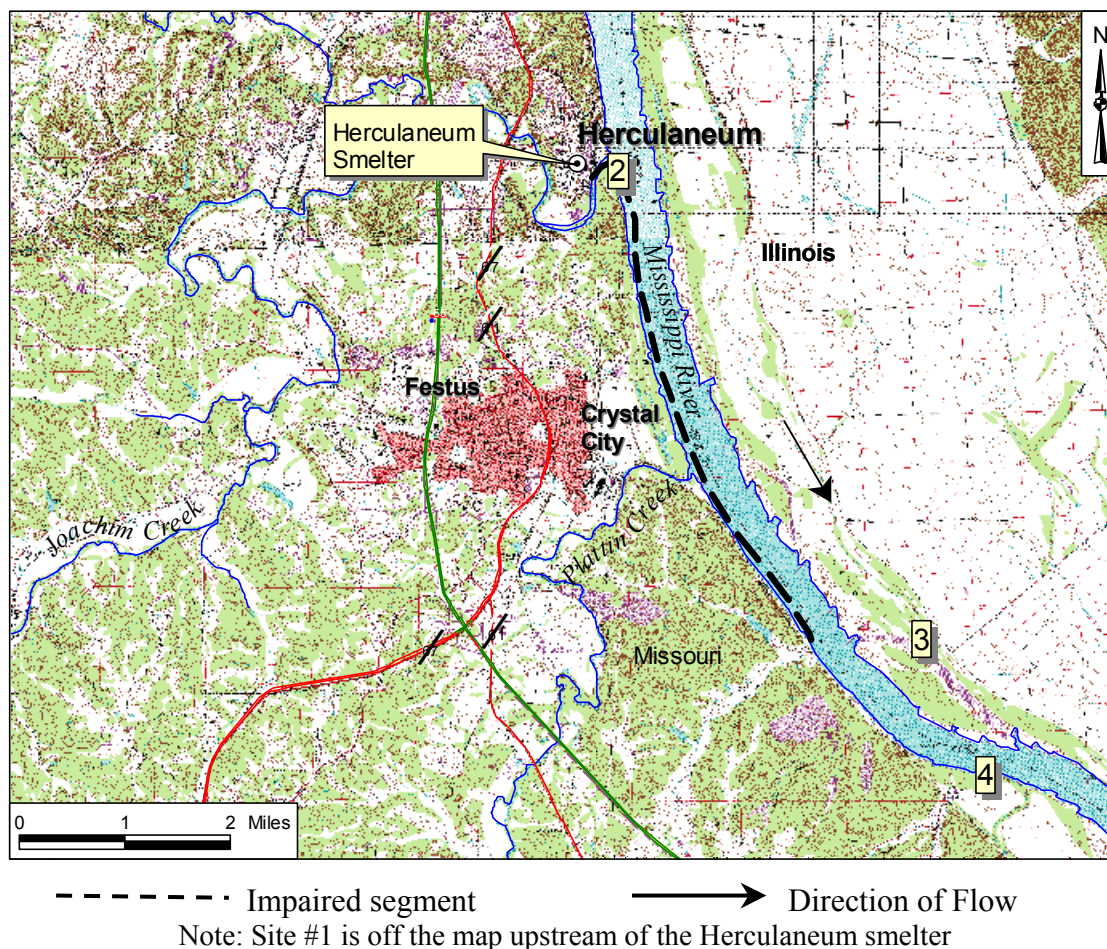
In 2001, the Missouri Department of Health and Senior Services (DHSS) conducted two special blood lead-testing events in Herculaneum. The second was conducted after high levels of lead contamination were found along the haul routes. On February 26, 2002, DHSS released a Health Consultation containing Herculaneum's blood lead testing results from January through December 2001 that included both special blood-lead testing events. Overall the rate of elevated blood lead (over 10 µg/dL) in children six years of age and under in Herculaneum was 28 percent. The rate of elevated blood-lead levels in children residing east of Highway 61-67 was 45 percent, which is the highest recorded rate in the state. Children under the age of six are of particular concern because of the negative effects that lead has on developing nervous systems. The DHSS also determined that the closer a child lives in proximity to the smelter, the more likely they are to have elevated blood lead levels.

In 2002, DHSS conducted another special blood-lead testing event and issued a Health Consultation on August 14, 2003, containing results from tests taken from January through December 2002. Overall, fourteen percent (14%) of children less than 72 months old tested in 2002 had elevated blood lead levels. Of those children residing east of Highway 61-67 (area closer to the smelter), seventeen percent (17%) had elevated blood-lead levels. Several factors may have been responsible for the reduction in the percentages of elevated blood lead levels in children from 2001 to 2002. These factors include reductions or elimination of exposure to lead through environmental actions in the community, changes in the operations of the Doe Run smelter, changes in home cleaning methods and in hygienic practices of residents, and increases in awareness of lead poisoning and its adverse health effects through childhood lead testing and health education efforts. In addition, a voluntary purchase program has been offered to residents living nearest to the smelter. As a result, some of the children in this area most at risk for lead exposure from the smelter no longer live in that area. Although the percentages of blood lead levels from 2001 to 2002 have dropped, the rate of elevated blood lead levels is still too high. Actions continue to be taken to reduce exposure to lead in Herculaneum residents, particularly those younger than 72 months (six years) old.

The department has developed a sampling plan for the Herculaneum area. The purpose of this plan is to determine the impact of the Doe Run lead smelter (Herculaneum) on the levels of metals and other pollutants in the waterbodies of this area. Water and sediment samples are being collected at various

locations in an effort to determine if a pattern of deposition exists. Joachim Creek and the Mississippi River are included in this sampling effort. The data will be used to determine if operational changes are needed at the Herculaneum Smelter. The MDC will continue to monitor fish tissue as part of this sampling plan.

Sampling Sites on the Mississippi River Near Herculaneum, Missouri



Sample Sites on the Mississippi

- 1 – River Mile 160, near Meramec River (not shown)
- 2 – River Mile 152, near Herculaneum Smelter
- 3 – River Mile 146.2, Osborne Channel (Illinois side)
- 4 – River Mile 145, La Rouche (behind short wing dam)

For more information call or write:

Missouri Department of Natural Resources

Water Protection Program

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